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Protecting Virginia's Transportation Infrastructure from Sea Level Rise

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By Cathy Henderson

7/12/2019

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Important

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Jacobs - Sustainability Goals

- Positively contribute towards the United Nations Sustainable Development Goals;
- Foster a culture of sustainability that promotes economic prosperity, environmental benefit and social value;
- Continue a dialogue with all of our stakeholders to raise awareness of sustainability and provide feedback on how we can do better;
- Enable knowledge sharing and capacity-building around sustainability across our enterprise and on all of our projects.

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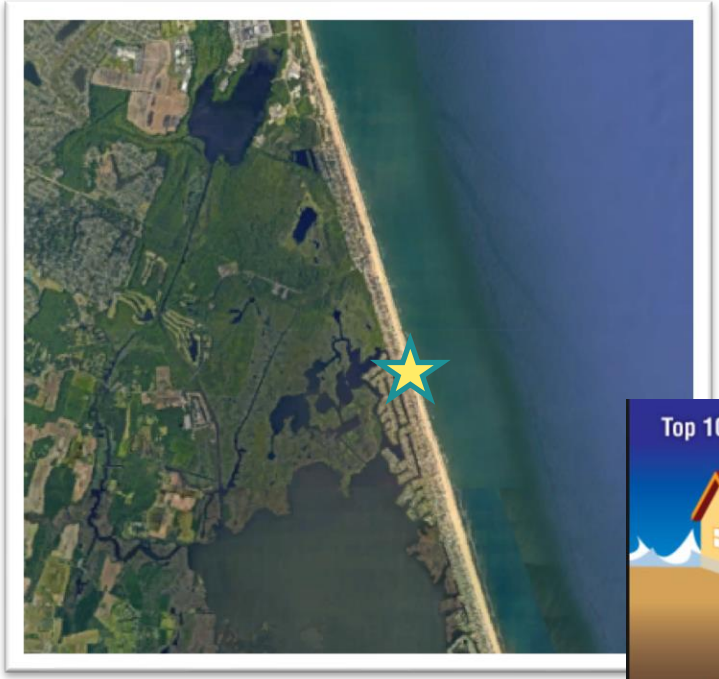
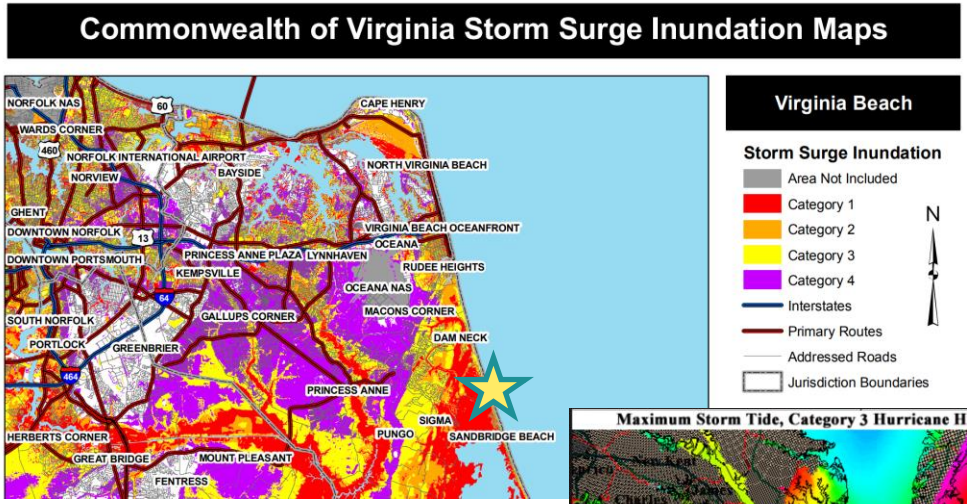
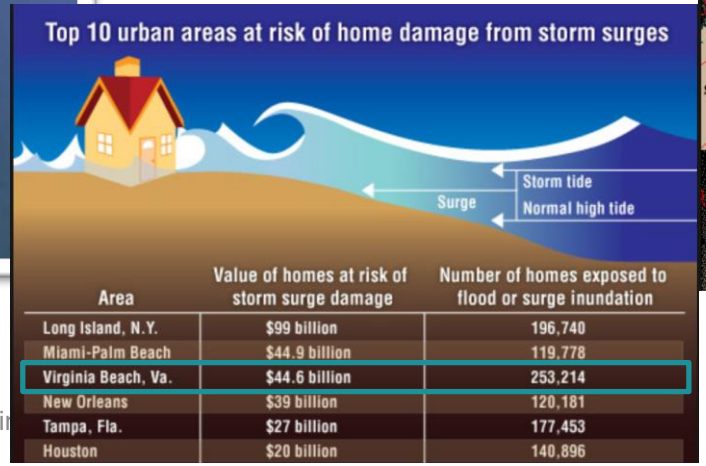
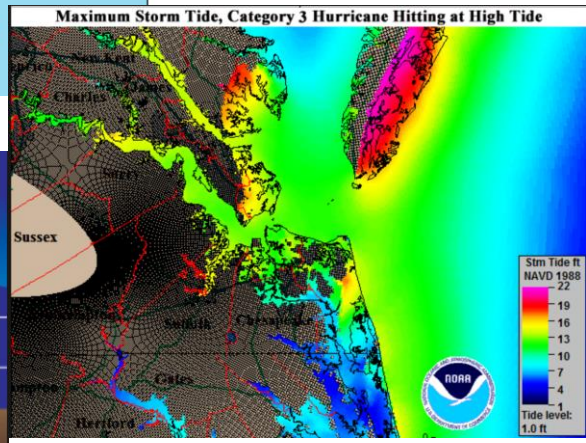
Introduction







Area	Value of homes at risk of storm surge damage	Number of homes exposed to flood or surge inundation
Long Island, N.Y.	$99 billion	196,740
Miami-Palm Beach	$44.9 billion	119,778
Virginia Beach, Va.	$44.6 billion	253,214
New Orleans	$39 billion	120,181
Tampa, Fla.	$27 billion	177,453
Houston	$20 billion	140,896



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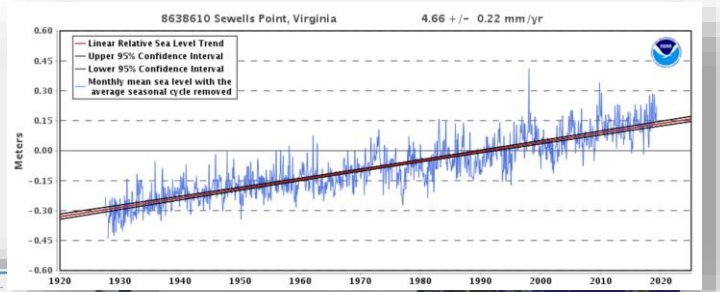
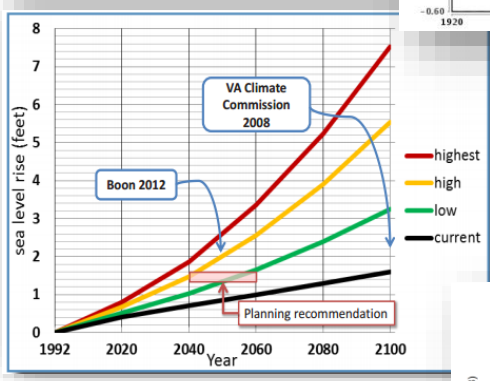
Overview

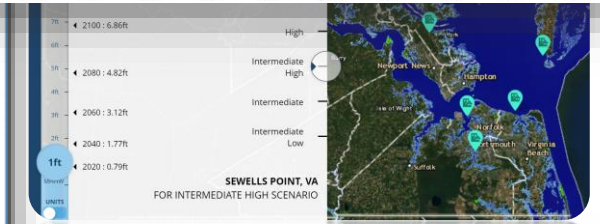
- Global & Regional Sea Level Rise
- Project Examples
- Design Impact
- Conclusion

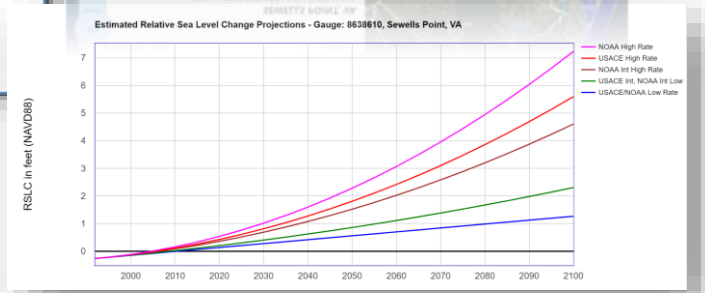
Global & Regional Seal Level Rise Data

- NOAA – Tides & Currents
- USACE/NOAA
- National Climate Assessment
- IPCC
- State & Municipalities
  - VIMS Scenarios
- SimCLIM









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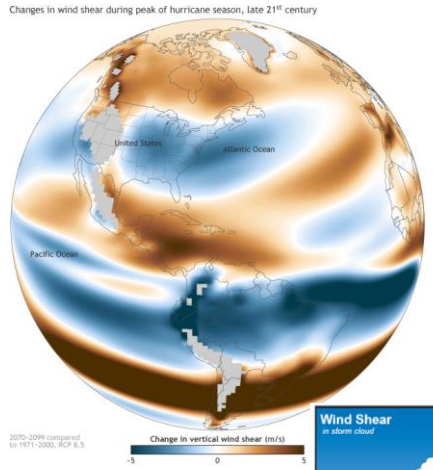
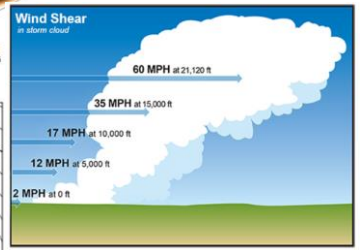
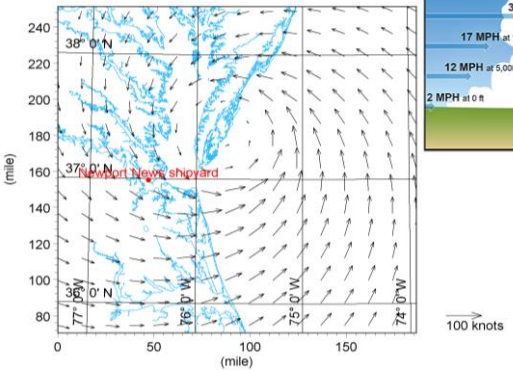
Global and Regional Sea Level Rise

1. Warming of sea temperatures and low wind shear = potential for ‘ideal’ storms.
2. Virginia Beach is in the top 10% of the highest relative sea level rise rates in the nation.
3. Land subsidence in southeastern Virginia (estimated at 0.1 inch/year). Regional subsidence has historically represented about one half of the change in relative sea level observed locally.
4. 40% of the U.S. population lives in a coastal area that might be vulnerable to SLR.







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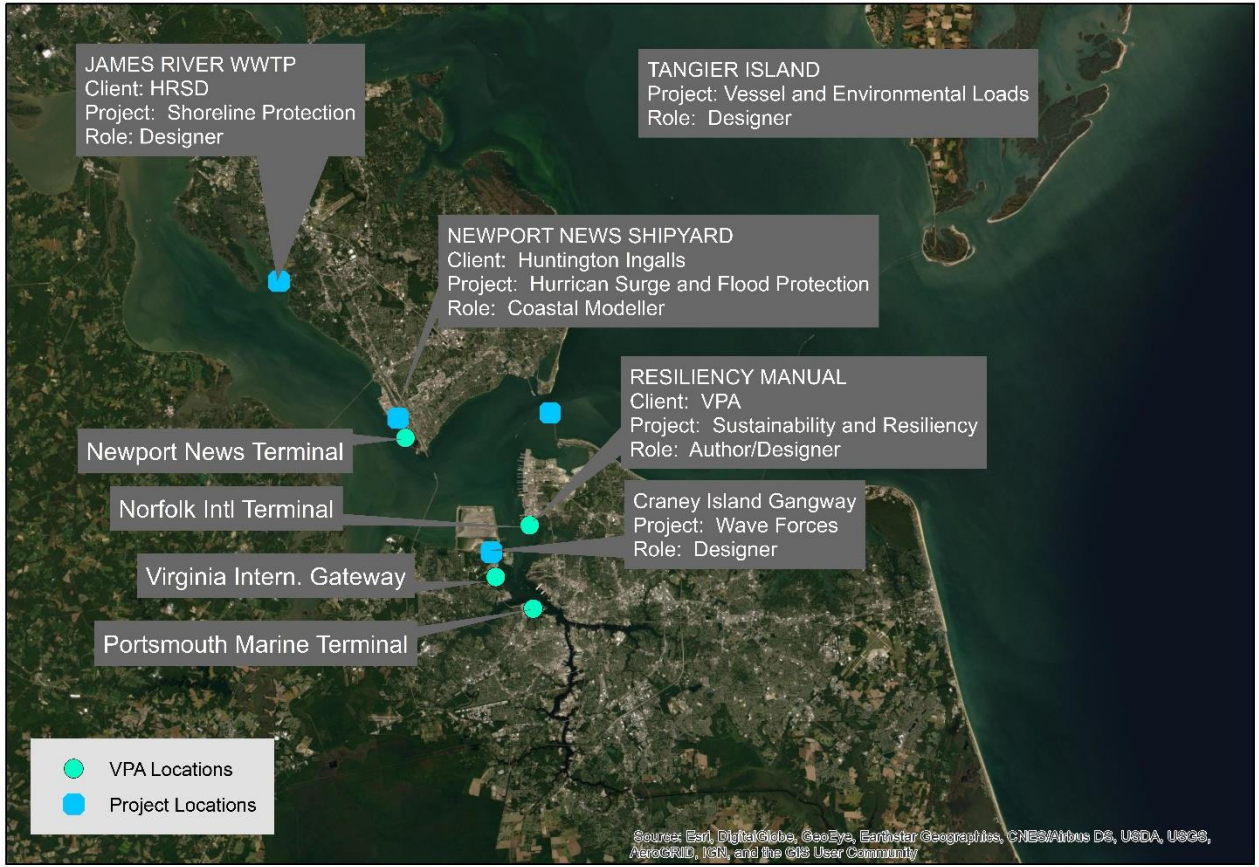
Projects Overview



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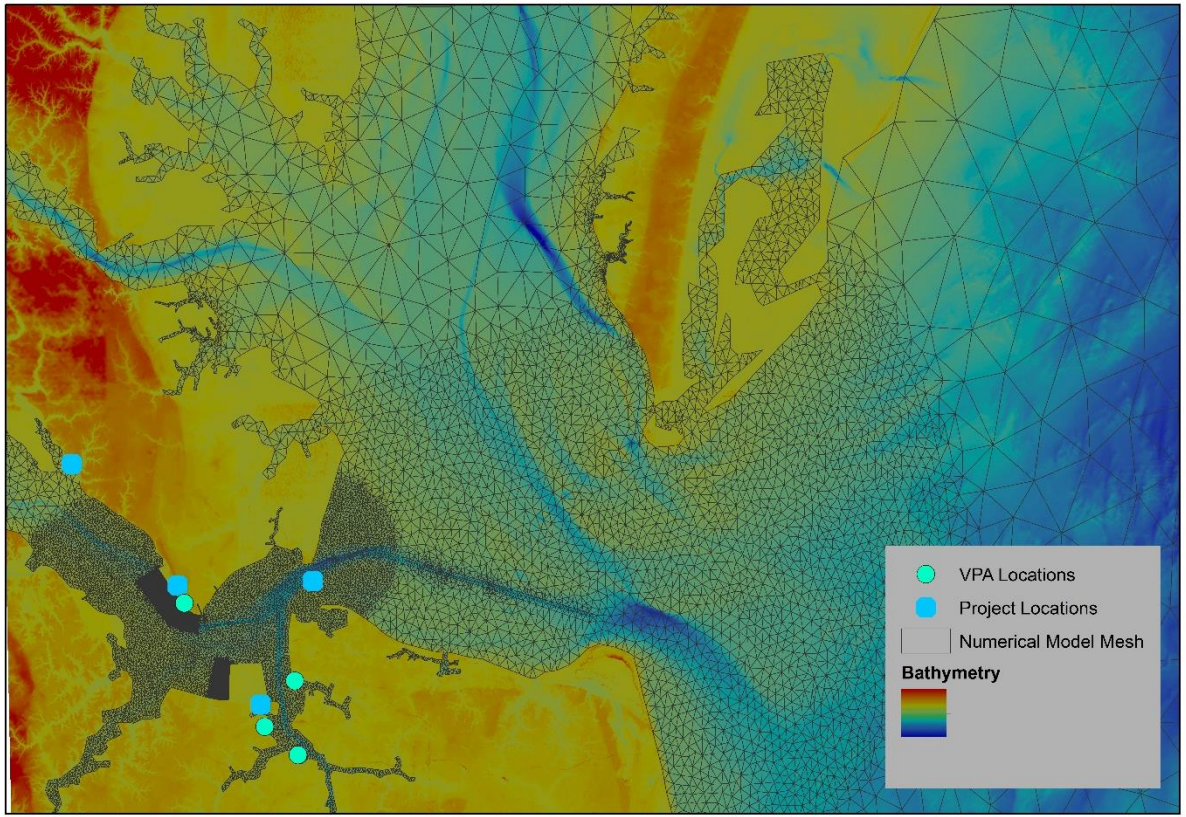
Projects Overview - Modeling



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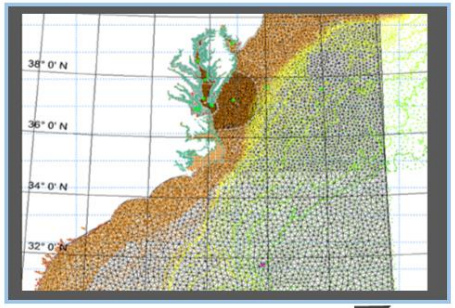
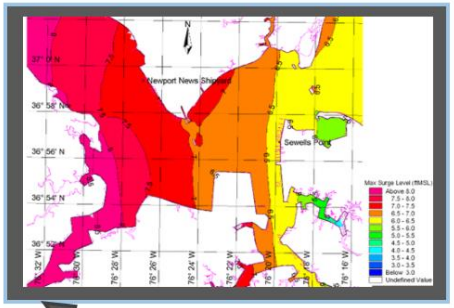
Project Overview - Modeling

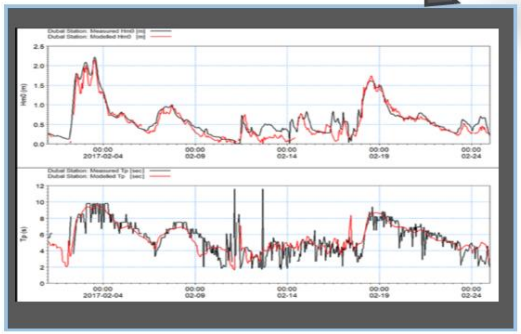


Model Mesh

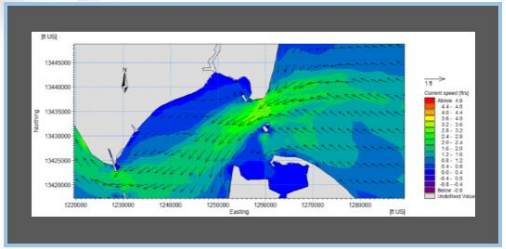


Hurricane & Storm Surge

DHI



Spectral Wave



Hydrodynamic

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Design – VPA Resiliency Manual

- Sustainability Goals
- 6 Terminals
- Temperature, Precipitation, SLR

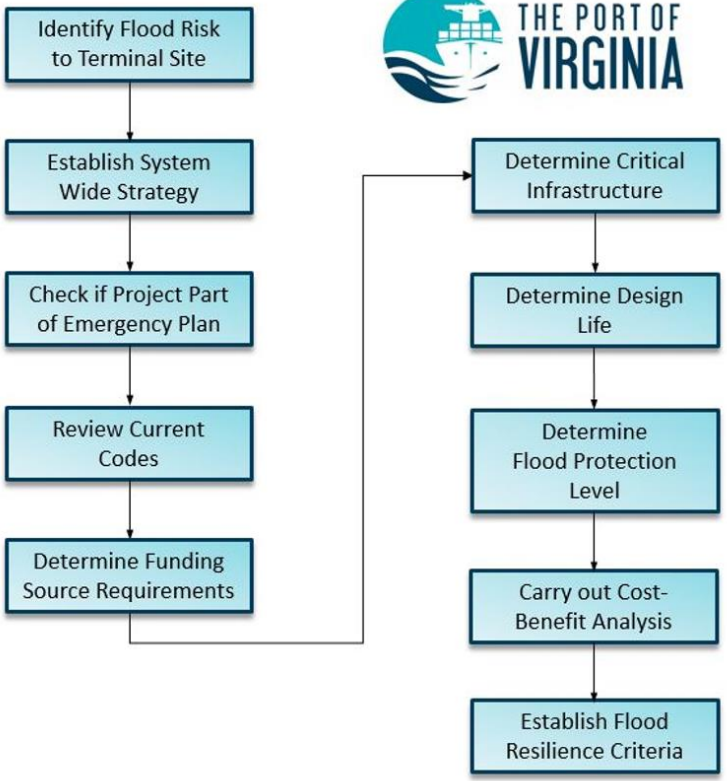
	Baseline (1901-2000)	2020s	2050s	2100s
Air Temperature	55.0 °F (Annual Mean)	Increase[1] by 0.2 °F	Increase[1] by 0.5 °F	Increase[1] by 1.0 °F
Precipitation	42.9 in (Annual Mean)	Increase[1] by 0.18 in	Increase[1] by 0.45 in	Increase[1] by 0.93 in
Sea level rise	Not Applicable [2]	6.0 in.	16.8 in.	39.6 in.

[1] Increase is from baseline.

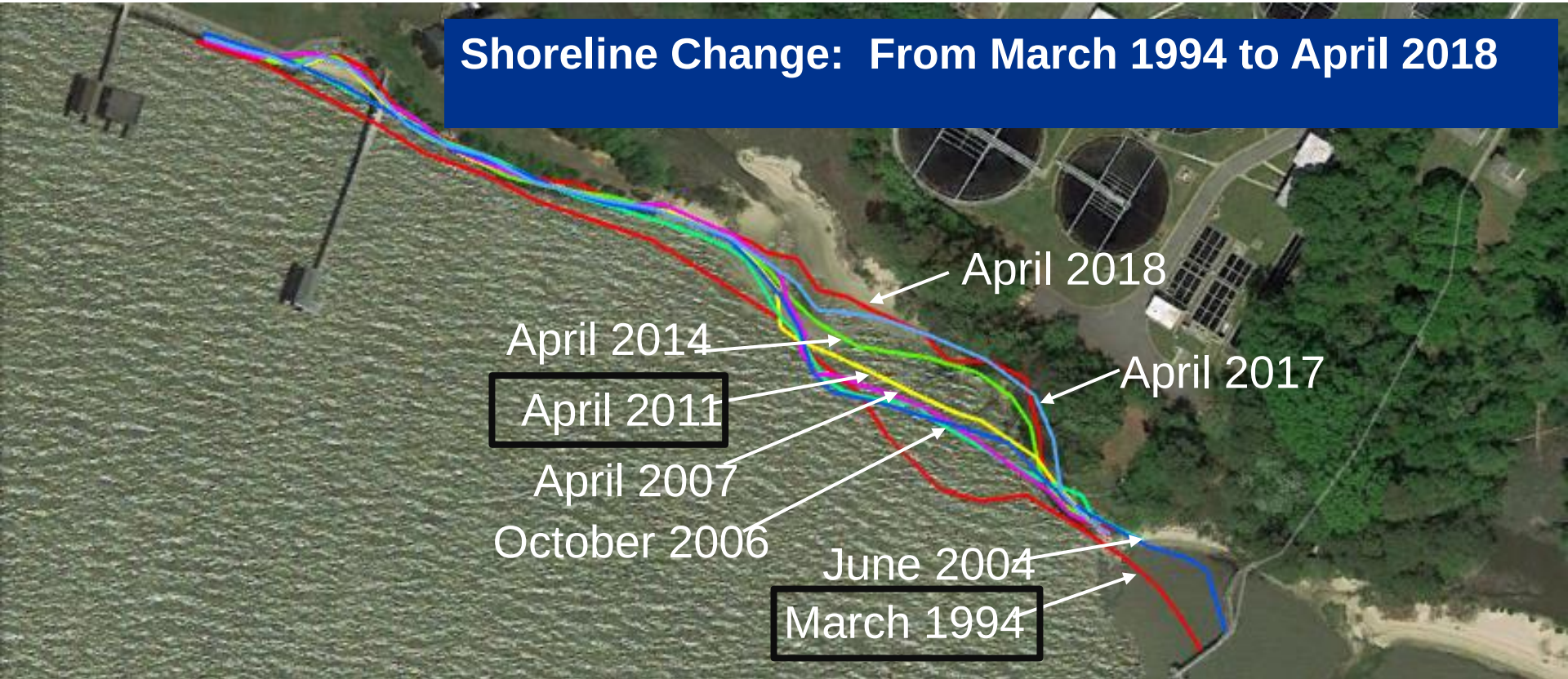
[2] For sea level rise, the values shown are added as part of the flood protection level.

Design – VPA Resiliency Manual

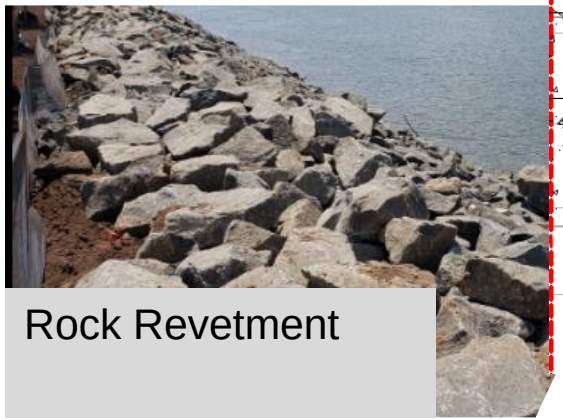
- Critical Infrastructure
- Resiliency Planning
  - Impact on Community
  - Enhanced Safety
  - Reduce Emergency Funds



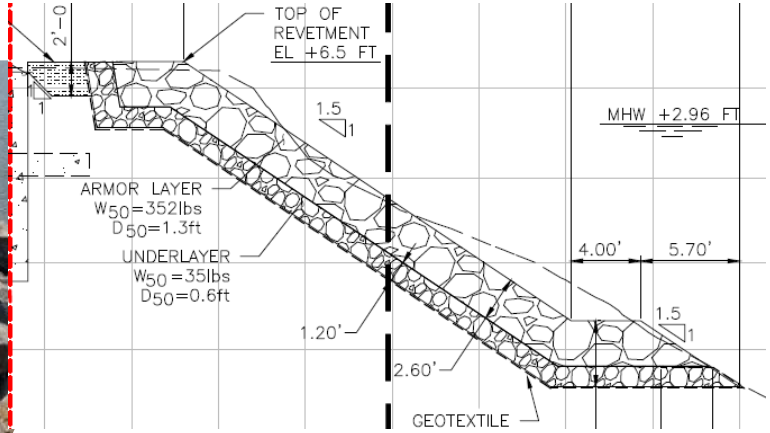
Design – JRWWTP

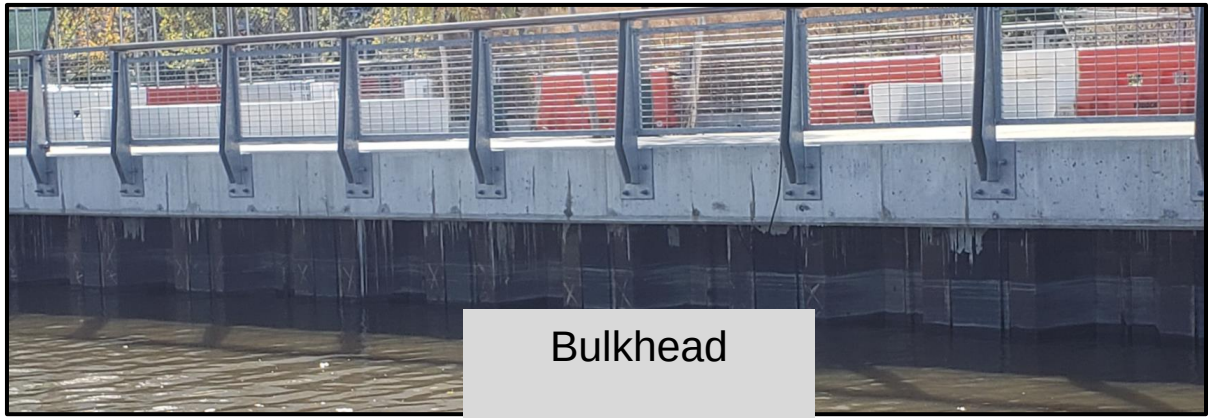


Design



Rock Revetment





Bulkhead

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Design – JRWWTP Oyster Reefs

- Living Shoreline Design
- Permitting
- Project Location

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Design Impact

- Critical Infrastructure
- Project Risks
  - Risk Management Approach (Immediate, Future and Residual)
  - Envelope of Scenarios (Permitting)
- Environmental and Economical Impact

Critical Infrastructure

- ASCE-7 & ASCE-24
- ASCE-24 freeboard requirements (Base Flood Elevations + 2 feet) for a Category IV structure:
  - Power distribution facilities (electrical substations, switch houses)
  - Emergency generators
  - Fire Protection Systems (mechanical, electrical, civil)
  - Fueling Systems

Project Risks

- Short-Term and Long-Term Risks

Acute Shocks (Short-term Duration)	Chronic Stressors (Long-term Duration)
Hurricanes	Environmental Degradation
Earthquakes	Sea Level Rise
Flooding	Aging Infrastructure
Tornadoes	Global Warming
Infrastructure Failure/Collapse	Increased Pollution/Contamination
Blizzards	Financial Shortages

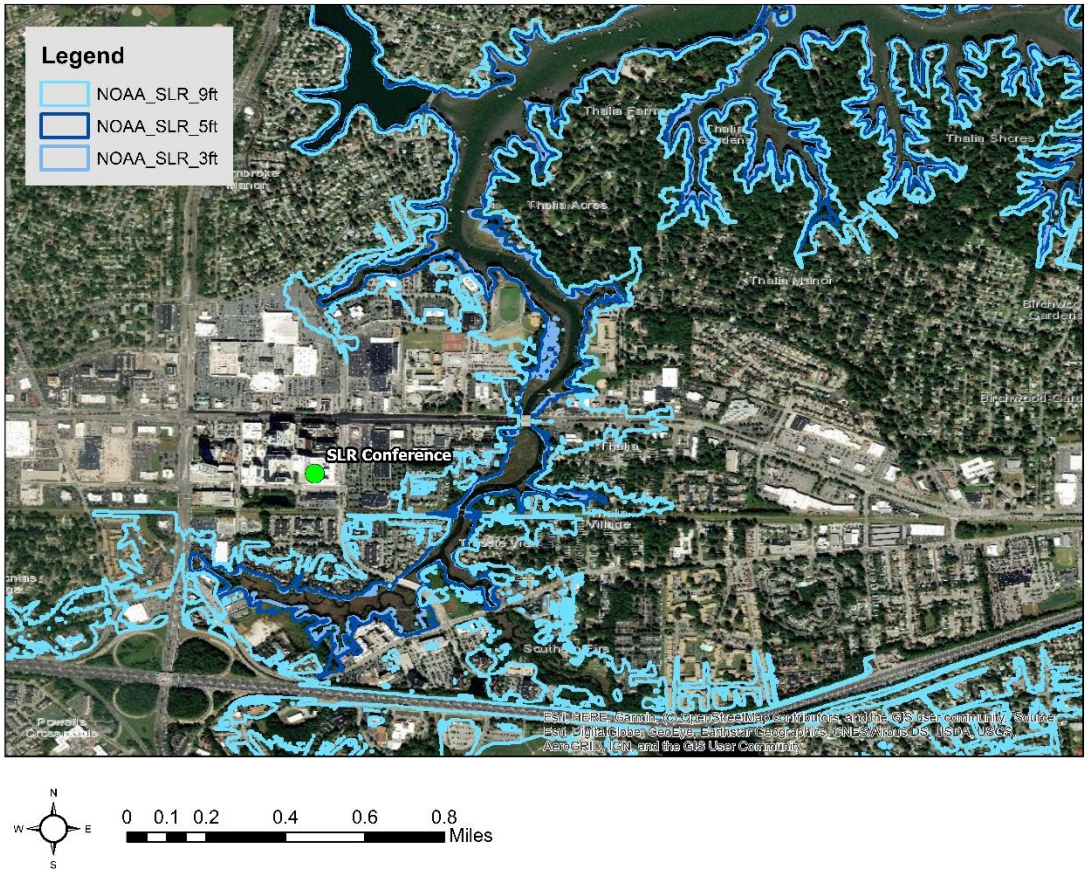
Source: Institute for Sustainable Infrastructure, 2018

Environmental & Economic Impact by Numbers

- **$4 Billion** - Sea Level Rise solutions for state of Virginia
- **$18.75 Billion** - US Property Loss from Hurricane Sandy
- **6,208** - Properties at risk from SLR in VAB – In 2033 estimated to become 8,096.
- **10th** – Rank of Norfolk-Virginia Beach Metropolitan Area in the world in value of assets exposed to an increase in flooding from sea-level rise.

Conclusion

- Sea Level Rise data uncertainty
- Protection of Infrastructure is a balance of Project Risks/Cost/Data
- Impact on Surrounding Communities



Thank You!

Questions?

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